Saskatchewan
Environment and
Public Safety

Water Objectives

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Forward

This document replaces the publication "Municipal Drinking Water Quality Objectives" June, 1980.

This document, "Municipal Drinking Water Quality Objectives", is intended for use by communities, operators, rural municipalities, consultants and other individuals involved with drinking water quality in the province. The objectives apply to waterworks regulated under The Water Pollution Control and Waterworks Regulations (June, 1987).

This document recognizes and reflects the development of new knowledge and more sophisticated analytical techniques which permit the detection of contaminants previously unknown in drinking water. In the light of this new knowledge and experience, it was necessary to re-assess the impact and potential hazards to human health of some of these substances.

Each supply is considered on its own merits and exceptions to the general chemical limits for constituents listed under 2.3 may apply if:

(a) test drilling indicates no other water sources is feasible;

(b) the resident users of the water are accustomed to it; and

(c) the limitations of the water supply are made known to the resident users.

In the future the department will be revising and updating these objectives as improved knowledge of various constituents/ conditions becomes available.

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Introduction

1.1 *General*

A "drinking water quality objective" is a numerical concentration or narrative statement which has been established to support and protect the designated uses of drinking water at a specific site.

The objectives are to be used with judgement and discretion. When considering exposure to the various parameters via water consumption it must be understood that there is exposure to these parameters through air, soil, food and other natural or man made products.

1.2 *Background*

The first comprehensive Canadian guidelines to specify recommendations and limits for substances and conditions which affect drinking water quality were published in 1968. The 1968 document was superseded with the 1978 guidelines.

In 1986 the Federal-Provincial Subcommittee on Drinking Water was established by the Federal-Provincial Advisory Committee on Environmental and Occupational Health and assumed the responsibility of revising and updating the national guidelines on a continuing basis. In 1987 new national guidelines for drinking water quality were published.

The new fourth edition published in 1989, contains several changes to the 1987 guidelines. These changes are reflected in this edition of the Saskatchewan objectives.

Some constituents in the provincial objectives such as: alkalinity, hardness, magnesium, sodium and total dissolved solids are specific to Saskatchewan.

1.3 *Purpose*

The primary purpose of the Municipal Drinking Water Quality Objectives is for the protection of public health. Water for drinking, culinary and other domestic uses should be safe, palatable and aesthetically appealing. It should be free from pathogenic organisms, hazardous chemical and radioactive substances and objectionable colour, odour and taste. Other aspects, such as corrosiveness, tendency to form encrustations and excessive soap consumption due to hardness are also important in determining drinking water quality.

Objectives for some of the parameters included in this document are more restrictive than those in the previous publication. Although it may not be possible to meet these more restrictive objectives in all water supplies immediately, it is recommended that every effort be made in the future to reduce concentrations of these contaminants to below the specified values.

A continuous effort should be made to ensure that drinking water is of the highest possible quality. Short-term excursions above the maximum acceptable concentrations do not necessarily mean that the water constitutes an undue risk to health. The amount by which, and the period for which, the maximum acceptable concentration can be exceeded without posing a health risk must be assessed by taking into account the toxicity of the substance involved. When the maximum acceptable concentration for a contaminant is exceeded, however, the minimum action required is immediate resampling.

1.4 *Explanation of Terms*

The following three types of terms shall be recognized:

1.4.1 **Maximum Acceptable Concentration (MAC)**
Maximum acceptable concentrations have been established for certain substances that are known or suspected to cause adverse effects on health. **They have been derived to safeguard health on the basis of lifelong consumption.** To the extent possible, the use of drinking water for all usual domestic purposes, including personal hygiene, has been considered in the derivation of the guidelines.

1.4.2 Interim Maximum Acceptable Concentration (IMAC)

In those instances where there are insufficient toxicological data to derive a maximum acceptable concentration (MAC) with reasonable certainty, interim values have been recommended, taking into account the available health-related data, but employing a larger factor to compensate for the additional uncertainties involved. An interim value was also established for those substances for which estimated lifetime risks to cancer associated with the guideline (the lowest level that was practicably achievable) were greater than those deemed to be essentially negligible.

1.4.3 Aesthetic Objective (AO)

These apply to certain substances or characteristics of drinking water which can affect its acceptance by consumers or interfere with practices for supplying good quality water. For certain parameters, both aesthetic objectives and health-related guidelines (maximum acceptable concentrations) have been derived. Where only aesthetic objectives are specified, the values are below those considered to constitute a health hazard.

Municipal Drinking Water Quality Objectives

The objectives for bacteriological, physical, chemical and radiological parameters are outlined in the following sections. All values are expressed in milligrams per litre, unless otherwise stated.

2.1 *Bacteriological*

2.1.1 **Total Coliforms**

The maximum acceptable concentration (MAC) for total coliforms is no organisms detectable per 100 ml of sample.

2.1.2 **Fecal Coliforms**

The maximum acceptable concentration (MAC) for fecal coliforms is no organisms detectable per 100 ml of sample.

2.1.3 **Background Bacteria**

The maximum acceptable concentration (MAC) for background bacteria is no sample should contain more than 200 colonies per 100 ml of sample.

2.1.4 **Heterotrophic Bacteria**

The maximum acceptable concentration (MAC) for heterotrophic bacteria is no sample should contain more than 50,000 heterotrophic plate count (HPC) bacteria per 100 ml of sample.

2.2 *Physical*

Parameter	MAC	AO
Colour		15 ACU
Odour		Inoffensive
pH		6.5 - 9.0
Taste		Inoffensive
Temperature		15°C
Turbidity	1 NTU	5 NTU

For the characteristics of water that are based on human sensory evaluation, judgement is often subjective.

Since the majority of consumer complaints regarding water quality relate to its colour, taste, turbidity, or odour, the quality of drinking water, as perceived by the senses, largely determines the acceptability of a particular water source.

Colour

The colour of drinking water may be due to the presence of coloured organic matter (primarily humic substances) or metals such as iron and manganese. Consumers may turn to alternative, perhaps unsafe, sources when their water is coloured to an aesthetically displeasing degree so it is desirable that drinking water should be colourless. The guideline is 15 apparent colour units (ACU). Levels of colour above 15 ACU can be detected in a glass of water by most people.

Taste and Odour

Some odours are indicative of increased biological activity. Sanitary surveys should always include investigations of possible or existing sources of odour, and attempts should always be made to correct an odour problem. The combined perception of substances detected by taste and smell is often simply called taste. Taste problems in drinking water supplies represent the largest single class of consumer complaints. Generally, the taste buds in the oral cavity specifically detect inorganic elements, such as magnesium, calcium, sodium, copper, iron and zinc.

Changes in the normal taste of a public water supply may point to changes in the quality of the raw water source or deficiencies in the treatment process.

As water should be free of objectionable taste and odour for the majority of its consumers, the guideline value is "not offensive".

pH

One of the main objectives in controlling the pH is to minimize corrosion and encrustation in the distribution system, which result from the complex relationships between pH and other constituents or characteristics, such as carbon dioxide, hardness, alkalinity, and temperature. pH levels of less than 6.5 may cause severe corrosion of metals in the distribution system. Elevated levels of certain chemical substances, such as lead, may result from the corrosion of specific types of pipe, and the rate of corrosion increases with decreasing pH. At pH levels above 9.0, there is a progressive decrease in the efficiency of the chlorine disinfection process.

An acceptable pH for drinking water in Saskatchewan is between 6.5 and 9.0. In the absence of a distribution system, the acceptable range of pH may be broader.

Temperature

Cool water is generally more palatable.

An aesthetic objective of 15°C has been set for the point of consumption.

Turbidity

The maximum acceptable concentration for turbidity is 1 nephelometric turbidity unit (NTU) for water entering a distribution system. A maximum of 5 NTU may be permitted if it can be demonstrated that disinfection is not compromised by the use of this less stringent value. An aesthetic objective of 5 NTU has been set for the point of consumption.

The presence of turbidity can have significant effects both on the microbiological quality of drinking water and on the detection of bacteria and viruses. Waterborne bacteria and viruses can be

embedded in, or adhered to, particles in the raw water. In addition, these organisms can be entrapped within floc particles formed during water treatment. Thus, turbidity in finished water can contain undesirable micro-organisms, which may not be detectable, or may be grossly underestimated by current detection methods. More important, however, is the capacity of turbidity - causing material to interfere with the disinfection process. Depending upon the composition of the turbidity, interference with chlorination can range from negligible to severe. It must also be noted that any sudden increase in the turbidity of the finished water indicates deteriorating quality of the raw water or loss of control in the water treatment process.

2.3 *Chemical - General*

Parameter	AO mg/L
Alkalinity (as $CaCO_3$)	500
Chloride	250
Copper	1.0
Hardness (as $CaCO_3$)	800
Iron	0.3
Magnesium	200
Manganese	0.05
Sodium (1)	300
Sulphate (2)	500
Sulphide (as H_2S)	0.05
Total Dissolved Solids	1500
Zinc	5.0

This category comprises certain chemical substances that could, if present in excessive amounts, interfere with the intended domestic uses of the finished water. These chemicals may be aesthetically objectionable, interfere with water treatment processes and distribution, or stain fixtures and plumbing. Aesthetic objectives have therefore been established for these substances.

(1) It is recommended that sodium be included in routine monitoring programs since levels may be of interest to

authorities who wish to prescribe sodium-restricted diets for their patients.

(2) There may be a laxative effect in some individuals when sulphate levels exceed 500 mg/L.

2.4 *Chemical - Health*

Parameter	MAC mg/L	IMAC mg/L	AO mg/L
Arsenic	0.025		
Barium		1.0	
Benzene	0.005		
Benzo(a)pyrene	0.00001		
Boron	5.0		
Cadmium	0.005		
Carbon tetrachloride	0.005		
Chromium	0.05		
Cyanide	0.2		
Dichlorobenzene, 1, 2	0.2		0.003
Dichlorobenzene, 1, 4	0.005		0.001
Dichloroethane, 1, 2		0.005	
Dichloromethane	0.05		
Dichlorophenol, 2, 4	0.9		0.0003
Ethylbenzene			0.0024
Fluoride (1)	1.5		
Lead (2)	0.01		
Mercury	0.001		
Monochlorobenzene	0.08		0.03
Nitrates as NO_3	45.0		
Nitrilotiacetic Acid (NTA)	0.4		
Selenium	0.01		
Tetrachlorophenol, 2, 3, 4, 6	0.1		0.001
Toluene			0.024
Trichloroethylene	0.05		
Trichlorophenol, 2, 4, 6	0.005		0.002
Trihalomethanes (THM) (3)	0.35		
Uranium	0.1		
Xylenes			0.3

This category comprises those inorganic and organic chemical substances that may be a hazard to the health of an individual if present above certain concentrations in drinking water. In general, the specified maximum acceptable concentrations have been derived by assessing the possibility of adverse effects after prolonged exposure.

(1) It is recommended, however, that the concentration of fluoride be adjusted to 1.0 mg/L, which is the optimum level for the control of dental caries. Where the annual mean daily maximum temperature is less than 10°C, a concentration of 1.2 mg/L should be maintained.

(2) Because lead is a component of many plumbing systems, first drawn water may contain higher concentrations of lead than are found in running water after flushing. Faucets should therefore be thoroughly flushed before water is taken for consumption or analysis.

(3) Trihalomethanes are formed in drinking water primarily as a result of chlorination of organic matter present in raw water supplies. It is, however, important to recognize the substantial benefits to health associated with disinfection by chlorination. The use of chlorine has virtually eliminated water-borne microbial diseases due to its ability to kill or inactivate essentially all enteric pathogenic microorganisms, including viruses and bacteria from the human intestinal tract. (Orme et al., 1990; US EPA, 1989). The maximum acceptable concentration of trihalomethanes in drinking water is 0.35 mg/L. Over the long-term, actual trihalomethane concentrations to which consumers are exposed should be reduced to less than 0.1 mg/L based on an annual average of seasonal samples. When more than one sample is collected in a winter, spring, summer or fall period than a seasonal average should be used to calculate an annual average.

Pesticides

The provincial objective is no detection of pesticides in drinking water. The MAC's sited below are those developed by Health and Welfare Canada for long-term health exposure.

Parameter	MAC mg/L	IMAC mg/L	AO mg/L
Aldicarb	0.009		
Aldrin + Dieldrin	0.0007		
Atrazine		0.06	
Azinphos-Methyl	0.02		
Bendiocarb	0.04		
Bromoxynil		0.005	
Carbaryl	0.09		
Carbofuran	0.09		
Chlordane	0.007		
Chlorpyrifos	0.09		
Cyanazine		0.01	
Diazinon	0.02		
Dicamba	0.12		
Dichlorodiphenyl-trichloroethane (DDT) + Metabolites	0.03		
Dichlorophenoxyaceticacid 2,4-(2,4-D)	0.1		
Diclofop-Methyl	0.009		
Dimethoate		0.02	
Diquat	0.07		
Diuron	0.15		
Glyphosate		0.28	
Heptachlor + Heptachlor Epoxide	0.003		
Lindane	0.004		
Malathion	0.19		
Methoxychlor	0.9		
Metolachlor		0.05	
Metribuzin	0.08		
Paraquat		0.01	
Parathion	0.05		
Pentachlorophenol	0.06		0.03
Phorate		0.002	
Picloram		0.19	
Simazine		0.01	
Temephos		0.28	
Terbufos		0.001	
Triallate	0.23		
Trichlorophenoxyaceticacid 2,4,5-(2,4,5-T)	0.28		0.02
Trifluralin		0.045	

It is recognized that the list of pesticides identified does not include all those available. The list constitutes only a small fraction of the number of such substances in Canada. When or if a pesticide not listed is detected in a water supply, advice should be obtained from the appropriate environment and/or health authority.

2.6 *Radiological*

Radionuclide	MAC Bq/L
Cesium-137	50
Iodine-131	10
Radium-226	1
Strontium-90	10
Tritium	40000

The guidelines for the radiological characteristics of water are based on the dose-response relationships as recommended by the International Commission on Radiological Protection (ICRP) in publication 26. Maximum acceptable concentrations in drinking water have been derived which correspond to 1% of the ICRP recommended annual occupational dose equivalent limit for continuous exposure. These guidelines can be calculated for other radionuclides using annual limits of intake (ALI) recommended by the ICRP in publication 30, using the following equation where an average daily intake of 2 litres of drinking water is assumed.

$$\text{MAC (Bq/L)} = \frac{\text{ALI}}{100 \times 2 \times 365}$$

Glossary

ACU (Apparent Colour Unit)
Includes not only colour due to substances in solution, but also that due to suspended matter. Apparent colour is determined on the original samples without filtration or centrifugation.

Aesthetic
Refers to those aspects of drinking water quality that are perceivable by the senses, namely taste, odour, colour and clarity.

Bacteria
Microscopic single celled micro-organisms which can be distinguished from higher organisms by their size range (diameters are usually in the range of 1.0 um) and the absence of a true cell nucleus (procaryotic cell construction).

Becquerel (Bq)
A unit of radioactivity which expresses the rate of disintegration of a radionuclide; one becquerel equals one nuclear transformation per second and corresponds to approximately 27 picocuries.

Coliforms (Total)
A group of bacteria found in feces, soil, vegetation and used as an indicator of bacteriological quality of water.

Coliforms (Fecal)
A group of bacteria found mostly in feces of warm-blooded animals.

Disinfection
Effective killing by chemical or physical processes of all organisms capable of causing disease.

Encrustation
The deposition of a crust or hard coating on a surface.

Groundwater
Water beneath the surface of land.

NTU (Nephelometric Turbidity Unit)
Unit of measurement for turbidity in a water sample. A formazin standard solution is prepared by dissolving 5 grams hydrazine sulphate and 50 grams hexamethylenetetramine in 1 litre of distilled water; after standing for 48 hours a solution prepared in this way has a turbidity value of 4000 units.

Parameter
Measurable or quantifiable characteristic or feature.

Pathogen
An organism capable of eliciting disease symptoms in another organism.

Pesticide
A substance or mixture of substances used to kill unwanted species of plants or animals.

pH
An index of hydrogen ion activity, pH is defined as the negative logarithm of hydrogen ion concentration in moles per litre. A solution of pH 0 to less than 7 is acid, pH of 7 is neutral, pH over 7 to 14 is alkaline.

Raw Water
Surface or groundwater that is available as a source of drinking water but has not received any treatment.

Radionuclide
A nuclide is a species of atom characterized by the constitution of its nucleus. The nuclear constitution is specified by the number of protons and neutrons and energy content; or alternatively by the atomic number, mass number, and atomic mass. Radionuclides are radioactive nuclides. To be considered as a distinct nuclide, the atom must be capable of existing for a measurable time.

Surface Water
Water which is above the surface of land and in a river, stream, lake, creek, spring, ravine, coulee, canyon, lagoon, swamp, marsh or other watercourse or body of water.